

REPORT
OF
WINDFALL DAMAGE AND SUBSEQUENT INSECT INFESTATIONS
ON THE
MOND LAKE-OWENS RIVER WORKING CIRCLE.

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SUMMARY

The volume of timber blown down in February, 1923, is estimated at twelve and one half million board feet on an area of about 32,000 acres. Nearly six million feet of this loss occurred on areas totaling 2640 acres where the percent of stand blown down ranged from 20% to more than 50%.

Barkbeetles began breeding in this down material during the season of 1923. No damage occurred in standing trees in or around the windfalls until the fall of 1924.

In August and September of 1924 thousands of trees near the windfall areas were top killed by Ips orexoni and a number of groups of trees of pole size were killed entirely. This attack in the fall of 1924 represented the peak of the Ips infestation. Very few trees were attacked in 1925 and in 1926 this barkbeetle did not attack any living trees on the area.

The Jeffrey Pine beetle was found to be breeding to a limited extent on the underside of logs which had remained green. In the fall of 1925 there was a pronounced increase of the attacks of this insect in standing trees. Many of these attacks were in trees topkilled previously by Ips. In 1926 the attacks of this beetle were altogether in standing trees and represented an increase over 1925. The 1926 infestation will average over 100 trees per timbered section and at present there is no indication of a decline from this epidemic condition.

The total loss in standing trees in 1924 and 1925 due to barkbeetles is estimated at six million board feet. About 48% of this loss occurred around the areas of heaviest windfall damage.

Control measures directed against the infestation developing in the down trees would probably have been impracticable in this situation. Prompt salvage of the windthrown trees appear to be the only feasible means of preventing similar loss of standing timber in and around areas of heavy windfall damage.

CONDITIONS ON THE WINDFALL AREAS.

More merchantable timber was blown down by the windstorm which visited the east side of the Sierra Nevada mountains in February, 1923, than by any similar storm in this region of which there is record. Evidence can be found of very old windfalls throughout this region but the damage does not compare with that of the more recent storm, either in extent of area covered or percent of stand blown down.

The wind which caused this havoc occurred on the night of February 18, 1923, and was of two or three hours duration. Its effects were noticeable from Minden, Nevada, to Independence, Cal. Not only were thousands of forest trees blown down, but damage to buildings, power lines, and other property resulted as well. So far as forest damage is concerned the greatest violence occurred near the Mono-Inyo National Forest boundary. No authentic records are available, however, as to the wind velocity in this section.

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The Mono Lake-Owens River Working Circle was the only considerable area of timber within the region affected by the wind, so that the loss of merchantable timber is largely confined to this area. As all down trees are pointed from southwest to northeast the wind was undoubtedly from the southwest during its height. The areas of heaviest blow down lie to the northeast of the comparatively low summits near Mammoth Pass. Apparently the higher crests to the south and north of this pass gave some protection to east of them.

By far the greater part of the timber blown down was Jeffrey pine growing on loose pumice soils. This tree species composes about 76 percent of the total stand of the working circle and it was largely in the pure Jeffrey pine type that the areas of heaviest damage occurred. Some white fir, and lodgepole pine were also included.

The effect of the wind in most cases was to throw the trees down leaving about half of the root system in the soil. Broken tops, trunks and similar damage such as might occur from winds of great violence are not in evidence. The loose soil of this region does not give a rigid support to the root system so that turning over of the entire tree is the result to be expected when an unusual strain occurs.

It was early realized that the vast amount of down timber still in a green condition would attract barkbeetles and other cambium feeding insects and that the unusual conditions arising would have some effect upon insect infestations for several years. Mr. Woodbury brought the situation to the attention of the Bureau of Entomology and suggested that a study be made of the area.

The first examination was made on July 27 and 28, 1924, by a party consisting of H.B.Burke, F.C.Craighead, H.L.Peterson and the writer. At this time an effort was made to determine only the character of the infestation that was breeding in the down logs. A second similar examination was made by the writer, July 27 to 29, 1925. A third examination was made by Ranger Simpson and the writer, August 28 to September 4, 1926.

On this last survey an effort was made to estimate the extent of the windfall areas, the volume of windblown timber and the extent and volume of standing timber killed by insects subsequent to the blow down. A general reconnaissance was made of the areas of heaviest damage and these were mapped by topography on the quadrangle sheets. Sample strips were run by compass through representative areas and counts made from records of insect killed trees. Altogether 17 miles of strip covering 976 acres of sample areas were run in this survey.

EXTENT AND VOLUME OF WINDFALL DAMAGE

The actual volume of loss caused by the storm is a very difficult quantity to estimate due to the very irregular distribution of the areas where the heaviest windfall occurred. There are certain small areas where the percent of stand blown down ranges from 20% to more than 50%. Aside from these

areas of conspicuous damage which can be fairly definitely outlined, there is a scattered loss of windblown trees which composes only a small percent of the stand. In this latter type of loss the windblown trees occur with so little regularity and are so concealed by the standing timber that without extensive surveys as a basis any estimates as to volume are nothing better than a guess.

Attached to this report is a map showing the location of the areas of more pronounced losses. The following is an estimate of the loss on these areas using as a basis the organization of the working circle and total stand figures in Mr. Barnes report of February 19, 1923:

Compartment	Acreage of heavy Windfall	Percent of stand blown down	Volume of Loss M.B.M.
Mammoth	100	15%	180
Dry Creek	400	24%	1,115
Deadman Creek	320	31%	1,190
Glass Creek	520	22%	1,372
Flatton	580	22%	1,724
Mono Crater	<u>320</u>	<u>20%</u>	<u>324</u>
	2,640		5,965

The areas of heaviest loss were found in Sections 3 and 4, T 3 S, R 27 E, along the state highway near the Mono Inye boundary, and in the area between Casa Diablo Lake and the Little Antelope Ranger Station.

In addition to the losses on the areas just listed are the scattered windblown trees that occur throughout the stand. My impression is that this type of loss extends over an area of approximately 30,000 acres with 2% of the stand blown down. With an average stand of 11,000 board feet per acre this would amount to a loss of 6,600 M.B.M.

The total loss for the working circle is therefore placed as follows:

Loss on 2,640 acres ranging from 15 to 30% of
stand 5,965

Loss of 30,000 acres averaging 2% of stand . . . 6,600

Total . . . 12,565 M.B.M.

INSECT INFESTATION PRIOR TO WINDFALL.

No surveys of insect damage were carried out on this working circle prior to 1923. Elredge in his first report upon this area, based upon the cruise made in 1906, makes no mention of insect damage. Barnes, who cruised the area in 1921 and 1922, mentions that damage by Dendroctonus jeffreyi "appears over the area in a moderate amount and indications point to local epidemics in the past".

During the examination made in July, 1924, strip counts along the roads near Mammoth gave a loss of between 10 and 20 trees per section from the 1922 and 1923 attacks of the Jeffrey pine beetle. This indicates a normal endemic infestation of D. jeffreyi preceeding the windfall. No evidence was noted of damage by Ips beetles prior to the same event.

INSECT INFESTATION IN WINDFALLS.

As the storm occurred in February 1923, no insects were flying until sometime in the late spring of that year. The material created by this windfall differs from slash in that as part of the root a stem remained in the soil and the foliage remained intact, the trees continued to live for sometime. However, a tree in this condition becomes quite susceptible to barkbeetle attack, particularly to certain species of Ips which do not breed successfully in vigorous trees. With the vast amount of suddenly created attractive material and only a very limited barkbeetle population on the area at the time, it required about two and one half seasons for the insects to increase sufficiently to infest all of the available down trees.

Ips oregoni.

The first noticeable attacks in the down trees seem to have been made by this species. These occurred in 1923. When the first examination was made July 28, 1924, at least two generations had developed in the windfalls during 1923 and one complete generation in 1924. Although there must have been a tremendous increase in numbers during these three successive generations less than 75% of the windfalls had been attacked. Many of the down trees still had green cambium and foliage when this examination was made 18 months after the blow down.

However, great numbers of the Ips beetles that emerged during the late summer and fall of 1924 did not reattack the green windfalls but attacked standing green trees instead. This resulted in the topkilling of large trees and the entire killing of trees of pole size. The most conspicuous areas of this 1924 killing were located between the Casa Diablo Lake and the Little Antelope Ranger Station and on the Deadman Creek drainage in sections 10, 22, and 28, T 2 S, R 27 E, M.D.M. On some of the centers in the Little Antelope area the attacks exceeded two trees per acre and the total amounted to thousands of trees. These attacks did not occur immediately in and around the heavy windfall areas but were usually found from $\frac{1}{4}$ to $\frac{1}{2}$ mile distant in areas where there were very few down trees. These centers of heavy Ips attack were usually located to the northeast of heavy windfalls which indicates that in the flight that occurred the beetles traveled with the prevailing wind.

This rather sudden attack on standing trees in the fall of 1924 could not have been entirely due to the exhaustion of the supply of wind thrown trees as there were still green windfalls on the area in the fall of 1925. The pronounced drought of 1924 probably had the effect of lowering the resistance of the standing trees so that they were quite susceptible to attack at the time when the great emergence of Ips beetles occurred during the late summer.

Although these attacks in standing trees developed some successful broods which emerged in the spring of 1925, the Ips infestation suddenly declined during the early part of that season. A few attacks occurred both in standing trees and in down logs during 1925 but quantitatively these were negligible compared with the infestation of 1924. No explanation has been found for this decrease except that the Ips beetles were unable to maintain an epidemic in standing trees and the few green windfalls that were left were no longer suitable for their brood development.

By September, 1925, Ips oregoni had practically disappeared from the area. During the examination of this season only one record of its occurrence was found, this being in association with D. jeffreyi in a standing infested tree.

Dendroctonus jeffreyi.

This species which is the principal insect enemy of the Jeffrey pine in this region, is not attracted to green logs or slash. Because of its aversion to "trap" trees it was not expected that it would occur to any extent in the windfalls. However, this beetle was found to be breeding on the underside of trunks of trees that retained a considerable amount of their root system in the ground. In no case was an attack found on the upper side of windthrown trees.

This limited attack of D. jeffreyi was not noticed in 1924 but in the examination of July 28, 1925, it was found that about 20% of the down trees had a small number of D. jeffreyi broods on the underside.

During 1923 and 1924 there was no change in the D. jeffreyi infestation in standing trees. The usual number of trees killed under endemic conditions continued. However, in the late summer and fall of 1925 there was a very pronounced increase of trees killed throughout the area by this beetle. Many of the larger trees that had been topkilled by the Ips outbreak in 1924 were attacked and entirely killed by D. jeffreyi in 1925.

The volume killed by D. jeffreyi in 1925 considerably exceeded that killed by Ips in 1924. The 1925 loss was also much more widely scattered and did not occur in pronounced centers except where large groups of topkilled trees had occurred the previous year.

In 1926 the attacks of D. jeffreyi were found only in standing trees and the infestation was apparently increasing over that of 1925. No large groups were in evidence but the infestation is fairly evenly distributed throughout the working circle and will average more than 100 trees per section. These 1926 attacks present an aggressive infestation with no evidence of a decline.

Flathead and Roundhead borers.

Practically all windfalls have been attacked to a varying degree by flathead borers. The common Melanophila gentilis which is capable of attacking living trees seems to be the most common species. However, practically no infestation of this insect has developed in standing trees.

The more common roundhead borers which are ordinarily associated with barkbeetle attacks do not seem to have been much of a factor in the windfalls. No down trees were found infested by these borers unless previously attacked by Ips or Dendroctonus.

VOLUME OF LOSSES CAUSED BY INSECTS.

No appreciable volume of standing timber was killed in 1925.

The volume killed in 1924 and 1925 was estimated by the sample strip method in September 1926. Because of the joint attack of D. jeffreyi in 1925 on trees topkilled by Ips in 1924, no effort was made to separate between the losses of these two seasons.

Six miles of strip, 2 chains wide were run by Ranger Simpson and the writer in and near representative windfall areas. All windthrown, standing green, and insect killed trees were tallied on these strips. On the 96 acres covered by this method, 68 insect killed trees were counted or .7 trees per acre. This condition is representative of approximately 5,000 acres in and around the heavy windfall areas.

Out side of the windfall areas 1924 and 1925 insect-killed trees were counted for a distance of 5 chains on either side of roads. Approximately 11 miles of road strip or 880 acres were cruised by this method. A total of 141 trees or .16 trees per acre were counted. It was considered that this type of loss which averages 102 trees per timbered section, extends over about 25,000 acres of the Jeffrey pine type. The total estimate for the area is placed as follows:

	<u>Acres.</u>	<u>Trees per acre.</u>	<u>No. trees</u>	<u>Average Volume b.f.</u>	<u>Total Volume b.f.</u>
Around heavy windfalls	5000	.7	3500	800	2,800,000
Outside of heavy windfalls	<u>25,000</u>	.16	<u>4000</u>	800	<u>3,200,000</u>
Total	30,000		7500		6,000,000

These estimates do not include the loss for 1926 which will have to be added to that which has already developed from conditions following the windfall. The 1926 loss promises to be at least 50% of that for the two preceding seasons or around 3 million board feet.

POSSIBILITIES FOR CONTROL.

The Jeffrey Pine beetle is at present the only insect causing serious damage. A control operation carried out against the overwintering infestation of 1926 would probably involve the treatment of about 2 million feet of infested timber. At a cost of \$4.50 per thousand board feet this would require a fund of \$9000.

The stumpage values of the timber and the possibilities of the present epidemic losses continuing are the main factors to be considered. The very limited demand for this timber at present renders rather doubtful the advisability of incurring a heavy expense for its protection. What can be expected on the part of the infestation during the next two or three seasons is only a matter of conjecture. I do not expect the present high rate of loss to continue for any great length of time as the epidemic apparently resulted from the unusual conditions of the windfall which no longer influence the situation.

This disaster opens up the problem of what can be done to avoid the heavy insect losses that usually follow windfall conditions. Treatment of the windfalls as they become infested with the purpose of preventing attacks in standing trees would have been entirely impracticable in this case due to the vast amount and scattered distribution of the windthrown material and the fact that the period of attack extended over three seasons.

The only other possibility for controlling the infestation would have been salvage operations. Had it been possible to log the areas of heavy damage within two years after the storm, the attack on the standing trees from barkbeetles coming out of the windfalls would probably have been prevented. However, market conditions and transportation facilities would have rendered this measure impracticable on the Mono Lake - Owens River working circle. Where market and transportation facilities are available, salvage operations appear to be the most practicable means of preventing the insect losses which usually follow heavy windfall damage in the pine type.



**Neg. #6194 - Area of heavy blowdown near Dry Creek, Sec. 4,
T 3 S, R 27 E M.D.M. Photo by J.M. Miller, August, 1926.**



**Neg. #6197 - Area of heavy blowdown near Dry Creek T 3 S, R 27 E M.D.M.
Very few of the surviving trees are attacked by barkbeetles within
these areas of heavy damage. Photo by J.M. Miller, August, 1926.**



Neg. #6199 - Windfall area near Sec. 16, T 3 S, R 28 E. The standing trees with white foliage have been either killed or top-killed by INA GRACIOSA. Photo by J.M. Miller, Sept. 1926.



Neg. # 6198 - Small windfall area in Sec. 17, T 3 S, R 28 E. The trees under the shelter of hill in background escaped. There is a prevailing wind from the S.W. A group of INA-killed trees can be seen in standing timber just to right of the windfall area. Photo by J.M. Miller, September, 1926.



Neg. #6195 - Trees killed in 1925 by the Jeffrey Pine beetle
near the Little Antelope Ranger Station, Sec. 16, T 3 S, R 28 E.

AREAS OF HEAVY WINDFALL DAMAGE Mono Lake- Owens River Working Circle

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Hatched areas represent 20% to 50%
of stand blown down. Survey of Aug. 28 to
Sept. 4, 1926.

T. 2 N.

T. 1 N.

T. 1 S.

R. 25 E.

T. 2 S.

T. 3 S.

T. 4 S.



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Insect Control
InyoSUPPLEMENTAL REPORT
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At the suggestion of Entomologist J. M. Miller, during his inspection of insect infestation last September, in order that information might be acquired by which it could be definitely determined whether the infestation is on the increase or decrease, a sample 640 was selected which is thought to represent average conditions of infestation in the Mono Mills - Owens River working circle, which comprises about 32,000 acres of Jeffrey Pine. Mr. Miller suggested that a 100% cruise of the insect-killed and infested trees on the E $\frac{1}{2}$ of Sec. 11 and the W $\frac{1}{2}$ of Sec. 12, T. 3, R. 27 E., M.D.M., be made. The cruise has been completed. The area, it was found, embraces, as nearly as can be determined, 432 timbered acres, estimated by Barnes to support a volume of 1,704,000 ft. B.M., or 12 M.B.F. per acre, practically 100% Jeffrey Pine. All insect-killed or infested trees were blazed and marked in accordance with the standard practice of the Bureau of Entomology.

Trees killed or infested during 1926 were designated "j" and marked consecutively beginning with No. 1 on each $\frac{1}{4}$ section.

Trees killed during 1925 were designated "I".

Trees killed during 1924 were designated "H".

All others were designated "G" and similarly numbered.

It is planned to re-cruise the section each succeeding year, and the results should indicate definitely if the infestation is remaining the same, increasing, or decreasing, and to what extent. Compilation of the cruise data, using the Site III table for Yellow Pine, gives the following results:

	Number Trees	Volume in ft. B.M.
1923 & before	165	244,670
1924	66	95,190
1925	60	95,230
1926	77	135,360
Total	368	570,450

Average volume b.f. - - 1550

If Barnes' cruise is assumed to be correct, it appears that more than 19% of the volume of the total stand has been killed or is infested during 1924, 1925, and 1926.

It will be noted that the volume killed during 1924 and 1925 are almost the same, while the 1926 volume represents an increase of 41% over the 1925 volume, and 30% increase in the number of trees killed or infested.

Of the 77 trees killed or infested during 1926, presence of *Pendroctonus jeffreyi* in some stage of development were noted in 66, and the insects had abandoned eleven. We were able to determine the presence of Ips in only one tree, which indicates a very great decline in the presence of that insect.

The infested trees are widely distributed over the entire section, which seems to indicate a wide-spread infestation over the entire Mono Mills-Owens River working circle.

One of the surprising features of the cruise was the size of the trees. The trees averaged 1550 ft. B.M., or the approximate equivalent of a 38" four-log tree.

As the cruising progressed, the windfall due to the storm of February, 1922, was counted. There are 215 trees on 432 acres, which gives some indication of the amount of timber felled by the storm. If we assume the trees to be of equal size and volume as the insect-infested trees cruised, that is, an average of 1550 ft. B.M. each, it would give the somewhat staggering figure of 25,800,000 ft. B.M. blown down in the Mono Mills-Owen River working circle.

Submitted: December 3, 1926

H.H. Simpson,

Forest Ranger,

Approved: Dec. 3, 1926

Roy Boothe

Forest Supervisor.

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c/c J.M. Miller
c/c Ranger McMurphy